Portable Water-testing Kit

Introduction

Safe drinking water is essential to good health, but conventional methods of water quality testing have depended on sophisticated laboratories and highly trained technicians largely unavailable in developing countries and remote communities in Canada. Without adequate water testing, people may unknowingly drink contaminated water containing viruses and bacteria linked to potentially fatal diseases such as cholera, typhoid fever, dysentery, and infectious hepatitis.

In 1984, IDRC took the lead to find a solution, funding research in Asia, Africa, and Latin America to evaluate existing water tests for their accuracy, simplicity, and cost. By 1989, researchers had selected four promising tests and adapted them for routine use in simple, community-based laboratories in the South. These tests are designed to confirm the presence or absence of microbiological agents linked to water-borne illnesses (see **How the water tests work**, below).

Meanwhile, the Cree community of Split Lake, Manitoba — frustrated by years of water-related health problems — approached Environment Canada for help. This led the Cree to IDRC, and Split Lake became the focus of a project whose goal was to determine if people in isolated communities could operate their own water-testing laboratories using local technicians and simple, inexpensive tests, and take preventative or remedial action based on the results. The project was so successful that in 1993 IDRC funded Cree technicians to train members of two indigenous Mapuche communities in Chile to test drinking-water quality.

"We proved these tests can be done at the community level by non-scientists," says Gilles Forget, Director of the Health, Society and Environment Program at IDRC. Health Canada and the Split Lake Cree subsequently launched a national program for training First Nations water-quality-control technicians based on one of the assays, the Presence/Absence test.

Impact

- **Lower cost tests -** On-site water tests cost CA $3 to CA $4 per sample, including the technician's salary. By comparison, it costs CA $20 to CA $30 per sample plus transportation costs to have water from a remote community in northern Ontario or Manitoba analysed at a commercial lab.

- **Faster remedies -** Rapid results mean water problems can be remedied more quickly. The tests provide results on-site in 24 hours to five days depending on which test is done. By comparison, results from commercial water-quality analyses used to take four to six weeks to reach Split Lake due to the paper work involved.
- **Frequent testing -** More frequent testing is now possible. Ideally some water tests should be done on a weekly basis. Communities can also test each family's water if necessary — essential in communities where households store water in barrels.
- **Communities empowered -** The simplicity of the tests enables people in isolated communities to perform the tests and interpret the results themselves. Building local ability to provide a basic community service has created a sense of empowerment and self-reliance in Split Lake and other First Nations communities that have adopted this approach.
- **Employment created -** "IDRC has created an awareness in Health Canada of the benefits of Presence/Absence water tests," says Jeff Moore, head of Health Canada's Drinking Water Safety Program, which now employs Split Lake water-quality-control technicians to train other First Nations people. Through this program, members from 26 indigenous communities in Canada have been trained to use IDRC's water tests, creating more than 20 part-time jobs as water-quality technicians. Another 51 indigenous communities have been funded to collect water samples using some type of Presence/Absence test.
- **Education increased -** Testing has led to an increased awareness of the causes of contamination and helped promote more hygienic water-handling practices. In four of the six communities where testing has been carried out for more than six months, local nurses anecdotally report a decrease in the incidence of diarrhea.
- **Technology transfer -** Through a technology exchange workshop sponsored by IDRC in August 1996, water-testing technology was also introduced to participants from Costa Rica, Guatemala, and Nicaragua. The impact of this project will multiply as more communities and countries adopt the technology.

How the water tests work

IDRC-supported research in Asia, Africa, and Latin America examined three older but sound technologies. These tests, along with the more recent coliphage test, have been adapted to serve the needs of isolated communities simply, reliably, and cheaply. All four tests assess water for the presence of microbiological agents linked to water-borne diseases. The tests can be done almost anywhere using commonly available materials and chemicals.

Two of the tests are particularly suited for monitoring drinking water quality. For the **Presence/Absence (P/A)** test, water samples are mixed with a special broth medium and incubated for up to five days at temperatures between 26°C and 35°C. A colour change from purple to yellow indicates the presence of contamination. In the **hydrogen sulphide (H_2S)** test, a treated paper strip is incubated with the water sample at temperatures between 25°C and 35°C. If bacteria are present, they will produce hydrogen sulphide, which turns the paper black. The test can also indicate the severity of water contamination.

The two other tests are best suited for monitoring recreational waters and water sources. The **coliphage detection test** indicates the presence of coliphages, viruses that accompany and prey on fecal coliform bacteria like *Escherichia coli* (E. coli). This is often a sign that other dangerous bacteria, viruses, or parasites transmitted by people may be present. To test for coliphages, water samples are incubated overnight at temperatures between 25°C and 35°C in petri dishes containing small disks of filter paper that hold the dried E. coli bacteria and nutrient media or agar. Clear spots in the cloudy agar after 8-24 hours of incubation mean the E. coli have been prevented from growing because the water sample is contaminated with fecal matter.

For the **A-1 Broth test**, water samples are incubated at 44.5°C for 24 hours in a series of tubes containing culture media. If fecal coliforms are present in the sample, they will multiply and produce gas, which will be visible in a second, smaller tube inverted inside the first tube. This test is very reliable, but requires a precise and higher incubation temperature.

Prerequisites

Three to five days training for local technicians; a laboratory with minimum standard equipment, including a balance, heating element, minimal glassware, and an inexpensive incubator to maintain an optimum temperature. A more sophisticated incubator is required for the A-1 Broth test.

Potential users

Isolated communities or decentralized laboratories responsible for routine water-quality testing. School laboratories interested in having students conduct experiments in applied environmental sciences.

Future outlook

The Mapuche people from Maquehue, Chile, are in the process of integrating regular water-quality monitoring into their communities. They are also working with the regional water authority to expand their community-based approach to other Mapuche communities in Chile, Panama, the Philippines, and Ireland have expressed an interest in community-based water testing. The Indonesian government is also assessing the possibility of using the H_2S test for routine monitoring of water quality in rural communities.

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Resources

IDRC will be publishing a manual in Spanish and English describing the Presence/Absence and H_2S tests along with several other household and community-based technologies for water treatment and protection. The Spanish manual is expected to be available by July 1997, AND the English version available in late 1997 or early 1998.

You Can Drink the Water. IDRC Reports.

Testing the Water: Milestones of Research. IDRC.

Supplemental information

IDRC is coordinating information on water quality for the following Website: **Global Applied Research Network in Water Supply and Sanitation (GARNET)**. GARNET promotes collaboration and information sharing among scientists and institutions in the North and South involved in water-quality monitoring research.